DOCUMENT RESUME

ED 032 128 PS 002 132

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Does the Use of Cuisenaire Rods in Kindergarten, First and Second Grades Upgrade Arithmetic Achievement?

Colorado Springs School District, Colo.
Pub Date Jun 69
Note-9p.
Available from-Director of Research, Colorado Springs School District Eleven, 1115 North El Paso Street, Colorado Springs, Colorado 80903 ($0.25)
EDRS Price MF-$0.25 HC-$0.55
Descriptors-*Academic Achievement, *Arithmetic, Arithmetic Curriculum, Grade 1, Grade 2, *Instructional Aids, Kindergarten, *Mathematics Education, Mathematics Materials, Three Dimensional Aids
Identifiers-Cuisenaire Rods, Metropolitan Readiness Test

This study is the final report of a three year project to find out if the use of Cuisenaire rods in kindergarten, first, and second grades upgrades arithmetic achievement. Both experimental and control schools enrolled children with average ability who came from lower middle class homes. Children in the experimental kindergarten classes were instructed individually in the use of the rods during each of the 3 years. Both the kindergarten experimental group of 30 children and the kindergarten control group of 23 children were given Test 5 (numbers) of the Metropolitan Readiness Test at the end of the second year. Though both groups did well, experimental students performed significantly higher. The first and second grade groups, who had worked with rods the previous year and two years respectively, were given the Metropolitan Upper Primary Test. Of 26 children in the experimental first grade group, 73 percent had arithmetic totals scores above 80 percentile of the national norming group. Of 19 children in the experimental second grade group, 68 percent were above the 80 percentile. The high test scores of all three experimental groups indicate that use of the rods does upgrade arithmetic achievement. (JF)

ED032128

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DOES THE USE OF CUISENAIRE RODS IN KINDERGARTEN, FIRST AND SECOND GRADES UPGRADE ARITHMETIC ACHIEVEMENT?

Lorna Dairy, Whittier School

PS002132

JUNE, 1969

1. DESCRIPTION OF THE PROJECT

In August, 1965, a five day instructional program on modern mathematics was sponsored by School District #11 at North Junior High School. One of the modern mathematics methods considered and demonstrated during this workshop was the use of Cuisenaire rods.

Eula Dougherty and Lorna Dairy, first grade and kindergarten teachers, respectively, were impressed with the potential of the rods and, at the conclusion of the workshop, they applied through the National Defense and Education Act for a classroom set of rods to be used at Whittier Elementary School. The request was granted and the rods were received in January, 1966. Mrs. Dougherty and Mrs. Dairy immediately started using the Cuisenaire rods in the classroom that year and have continued to do so since that time.

In September, 1966, a request was filed by Mrs. Dougherty and Mrs. Dairy for permission to set up a research program to evaluate the use of rods. Such research was to continue until June, 1969, at which time the children then enrolled in kindergarten would have had the use of rods incorporated in their number work from kindergarten through second grade. The request was granted and a plan of evaluation was set up in consultation with the principal of Whittier School, M. Roy Langford, Dr. Robert Sheverbush and Dr. Roslyn Grady from the Department of Research and Special Studies of Colorado Springs Public Schools.

2. PROCEDURES

It was decided that the control groups would be from Columbia School, considered comparable in intellectual, social and economic backgrounds to the experimental groups at Whittier. Both schools enroll children with average ability who came from lower middle class socio-economic homes.

Test 5 (numbers) from the Metropolitan Readiness Test was to be given in the fall of 1966 to both experimental and control groups in the first grade at Whittier and Columbia Schools and the same test was to be given in the spring of 1967 to kindergarten children in the two schools. Test 5 was also to be administered to experimental and control groups in the kindergartens in the spring of 1967 and 1968.

The arithmetic section of the Metropolitan Upper Primary was to be given to each one of the experimental and control groups during the second grade for the next three years.

To be used as factors, in addition to test results, would be teacher judgment, parent answers to questionnaires concerning the use of the rods and parental evaluation of child's attitude concerning mathematics.

Children in Mrs. Dairy's kindergarten classes were instructed individually in the use of the rods during the three years the research has been in progress. Twenty-five children still residing in the Whittier School district who had been in the kindergarten class receiving rod instruction comprised the classes. Mrs. Dougherty gave forty-five minutes of number work using the Cuisenaire rods during the two successive years, 1967-68 and 1968-69. This first group of twenty-five youngsters from the school year 1967-68 was instructed during the second grade by Mrs. Dairy for a thirty to forty minute period. At the end of the 1968-69 school year, only nineteen of the original twenty-five still remained in the Whittier district.

In the first grade classes, Mrs. Dougherty devised her own worksheets to be used for the rod work. In addition to the rods, the Laidlaw series workbooks for the first grade were used in the classroom during other periods and the rods were used in conjunction with these books as new concepts were being developed.

The children in the second grade class worked with the Laidlaw workbooks individually and asked for help from the instructor when necessary. These same children completed from three hundred to nine hundred worksheets for use with the rods. Each pupil had a seperate folder containing the sheets assigned on the basis of ability and understanding and proceeded at his own pace. The class worked as a unit only with geoboards to develop understanding of geometrical figures and with measurement of lengths and liquid measures. Money values were taught, using real money with individual children, and then these values were translated into Cuisenaire rod values until the class instructor felt that the children understood the concept sufficiently.

3. OBSERVATIONS

Mrs. Dougherty pointed out that, prior to her use of Cuisenaire rods in her mathematics classes in the first grade, she had found that the children were only able to complete one hundred twenty pages in the Laidlaw workbooks by the end of the year and this they did with considerable difficulty. Since using the rods, the entire book of one hundred ninety pages were completed with ease.

Mrs. Dairy's remarks at the conclusion of this past year follow: "My enthusiasm for the use of Cuisenaire rods in the teaching of mathematics has grown tremendously each of the three years I have used the rods. I never cease to be amazed at the interest of the children nor the rapidity with which they grasp the concepts as they use the rods. I have watched highly intelligent children advance on their own without any adult pressure to achieve. I have also watched culturally deprived children come to life intellectually with the understanding of rods.

Frances L. Jenkins, mathematics supervisor in the Division of Secondary Education, Colorado Springs Public Schools, visited the kindergarten classroom for an hour and a half in April, 1968. Her observations included the following comments: "I found that, instead of the rods being crutches, the children discarded them as soon as they were no longer needed--and they made that decision. I found the pupils doing quite sophisticated problems for their maturity level and doing them with excellent understanding of the mathematics involved, as evidenced by their working aloud together and their responses to questions."

4. ANALYSES OF RESULTS

The kindergarten in both control and experimental groups were given Test 5 (numbers) from the Metropolitan Readiness Test during May of 1968. Results of this test are shown in Table I below.

TABLE I

KINDERGARTEN RESULTS ON METROPOLITAN READINESS TEST FIVE--NUMBERS

	Raw Score Mean	S.D.	%ile Rank	t	p
Experimental N = 30	20.1	3.39	96	3.16	.01
Control N = 23	17.1	2.12	89		

Both groups did well, but experimental students performed significantly higher. It is possible that the experimental group has higher ability.

In the fall of 1969, the first grade children in the Cuisenaire rod program were given Test 5 (numbers) and results are shown in Table II.

TABLE II

FIRST GRADE RESULTS METROPOLITAN PRIMARY I BATTERY, ARITHMETIC SECTION

Groups	Mean Readiness		Expected Results		Actual Results	
	Standard Score	%ile	Mean Standard Score	%ile	Mean Standard Score	%ile
Experimental	71	83	57	83	57	83
Control	66	73	53	73	52	70

It was impossible at the control school to get enough students scoring high enough on the Metropolitan Reading Test in September, 1967, to match with the experimental group. Results were compared on the basis of what students would be expected to gain as a function of their readiness scores. No significant difference was found when results were interpreted in relationship to the mean readiness score secured in the testing program. One reason put forth was that innate ability was higher in the experimental group. The other possible reason was that the number work the experimental group had during the previous kindergarten year could account for the high score of the experimental group on the readiness test. The latter seems the most plausible, especially in terms of the achievements of this group as evidenced during the year. The experimental group finished the entire Laidlaw number book of one hundred ninety pages with ease.

Results of tests made in the spring of 1969 are shown in Table III below. All statistics presented are from the experimental classes at Whittier School.

TABLE III

Grade	Items	Range of Scores	Mean	Mean %ile	Scoring above the 80th %ile
K N=30	26	22-26	23.52	98	100%
1 N=26	63	49-62	58 G.E. = 2.6	85	73%
2 N=19	72	48-68	63 G.E. = 3.5	87	68%

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From these results, it can be seen that the Readiness Test used in kindergarten or at the beginning of grade one did not challenge this group of youngsters. Fifty percent of the group had either perfect scores or only missed one or two items in the number section. It is probable that many things they have learned in the Cuisenaire rod program were beyond what the test measured since so many scored near the ceiling of the test.

The first grade group at Whittier included the twenty-six children who had worked with rods the previous year in kindergarten and in the second grade class were the nineteen pupils still enrolled at Whittier who had worked with Cuisenaire rods during both kindergarten and first grade. Both first and second grades took the mathematics section of the Metropolitan Upper Primary Test. Using end-of-the-year norms, the first grade group's average was at the 85%ile and the second grade group's average was at the 87%ile. Seventy-three percent of the first grade group and sixty-eight percent of the second grade group had arithmetic total scores above the 80%ile of the national norming group. The mean IQ for the group was 101.

5. CONCLUSIONS AND RECOMMENDATIONS

The high test scores of all three experimental groups would indicate that the use of Cuisenaire rods does upgrade arithmetic achievement. Other factors which affected the results that must be considered are (1) the enthusiasm of the teachers, (2) individualization of instruction at the kindergarten level, (3) lower-than-average class size in the second grade group.

Both teachers have maintained their high point of interest in the use of the rods primarily because they have seen so much evidence of an improvement of attitude toward the subject of mathematics on the part of the children. Not one child in any of the experimental groups has

failed to show both interest and optimal achievement as judged by the teachers. Both teachers have willingly spent additional hours in preparation, devising rod sheets to be used in the program and grading the large numbers of worksheets the children have completed during each instructional period.

In analyzing the results, both Mrs. Dougherty and Mrs. Dairy feel that they have learned a great many ways, during the progress of the research, to improve techniques in the presentation of the materials. Each year, kindergarten children in the program have seemed to be further along in their understanding of numbers by the close of the school year. This is also true in the other two grades, according to teacher judgment, but the statistical evidence is not as great.

Because of the age and immaturity of the kindergarten child, the writer feels that each child must be taught individually when he learns a new process. This has involved a great deal of time and patience and it would have been impossible in a structured kindergarten in a public school class of more than twenty-five children. Interested mothers have helped with art instruction at least twice a week and during this time the teacher has been free to introduce the Cuisenaire rod program to individual children. Children in Whittier kindergarten are free to pursue any activity available in the classroom in so long as they follow behavioral rules set up by the group. Most of the time that is spent on group instruction has to do with written work involving the writing of letters and numbers early in the school year.

Because of the small size of the second grade class, it was possible to work informally with the youngsters and to give a great deal of individual help as the year progressed, both with the workbooks by Laidlaw and the rod sheets. Interesting to note is the fact that the pupils are

practically independent of the use of the rods by the end of the year, but the teacher still thinks that they are invaluable in learning new concepts.

It is recommended that it might be possible to tape a series of lessons which could be used on the listening table even in kindergarten classes.

Only those teachers who are enthusiastic about the project should attempt to use the rods because they are noise producing, a task to keep in containers and they do involve additional work on the part of the classroon teacher.